Seasonal Dynamics of the Citrus Peelminer in Tulare County

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The citrus peelminer (CPM) [*Marmara gulosa* Guillen and Davis; Lepidoptera: Gracillariidae] is a small moth native to the southwestern United States and northern Mexico. It feeds by mining just below the surface of succulent stems, fruit, and occasionally leaves of its host. Historically, CPM has been a minor pest of citrus in the San Joaquin Valley (SJV), primarily in grapefruit in Kern County, with infestation rates rarely exceeding five percent. The CPM has a large host range but has remained an economic problem almost exclusively in citrus. Since the winter of 1998 through 1999, CPM infestation rates in grapefruit and other citrus varieties in the SVJ have increased dramatically (30 to 80 percent of the crop). Additionally, the host range of CPM has expanded to include 67 species in 31 plant families, including crops such as citrus, walnuts, stone fruit, almonds, melons, cotton, olives, and grapes. Therefore, because of the differences observed in the behavior of the current infestation, the source of the infestation was traced. After the freeze in 1998, bulk citrus from the Hermosillo and Ciudad Constitucion areas of northern Mexico, arrived at packinghouses in the Lindsay/Strathmore area. This fruit was infested with an insect that morphologically was identical to CPM found in the Coachella Valley. Given the differences in host range of this insect compared to that in the Coachella Valley, it was assumed that the CPM in the current infestation is a new strain or biotype. Studies comparing the molecular biology of the insects from the SJV with those from the Coachella Valley are currently underway at University of California, Riverside.

A study was conducted to determine the seasonal sequence of habitat use by CPM in Tulare County. One objective was to determine if there are habitats in which management tactics could be applied to reduce the pest pressure from CPM. Five sites located on the east side of Highway 99 from Earlimart to Farmersville, were selected for study. Each site had at its center a mature table grape vineyard (over three years of age). Sites were chosen that had large densities of CPM in 2001 (D. Haines, unpublished data). Each site was sampled at two-week intervals from late May through the end of October, and about once per month in November, December, and January.

Ten vines were selected at random on each edge of the vineyard. On each vine, the number of active (i.e., mines with live CPM larvae) and inactive (i.e., mines without live CPM larvae) mines found on up to one-meter length of a green cane (i.e., first year cane) was recorded. When clusters were present, one cluster near the sampled green cane was examined and the number of berries within the cluster containing active or inactive mines was counted. In habitats adjacent to the target vineyard, a 10-minute search was conducted. The number of active and inactive mines found, and the plant parts with mines were recorded.

The results from this study are consistent with two general patterns of seasonal dynamics. In one pattern (Sites 1, 2, and 3), cotton and dry beans influence CPM dynamics in grapes, and for the other pattern (Sites 4 and 5), citrus and nursery plants influence the dynamics.

The first pattern of CPM abundance in a table grape vineyard, as demonstrated by the data from Site 3, was characterized by a small peak in abundance in June, followed by a broad peak in abundance from mid July through September (Figure 1). Mining of green canes by CPM could be found as early as May. Mining of the main stem was found from mid June through October. No berry mines were found in this vineyard. The peaks in CPM density in the table grape vineyard appeared to be related to the density changes found in the surrounding habitats (Figure 2). The pattern in table grapes closely followed the pattern from cotton. CPM density in

cotton declined in late June through mid-July probably due to the application of the insecticide aldicarb to the cotton crop. This insecticide treatment is part of the standard management program for controlling early season pests in cotton. In late July, as the effects of the insecticide diminished, the density of CPM again increased through August and September with mining found in main stems, lateral branches, and bolls.

Figure 1. The Mean Number of Active CPM Mines Per Centimeter of Green Cane at Sites 3 and 4 in Tulare County in 2002

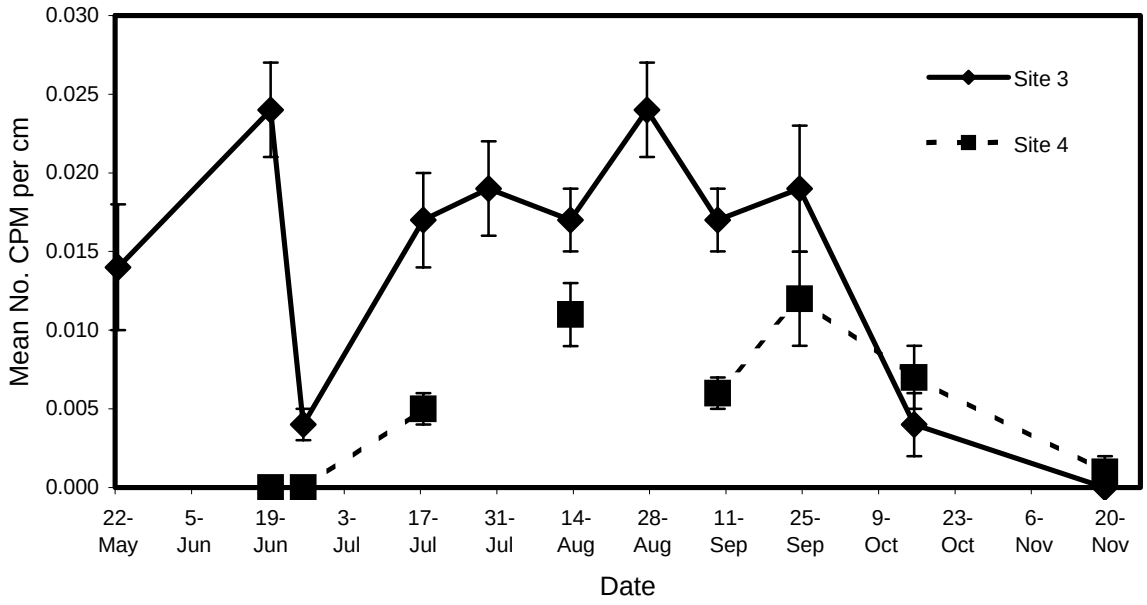
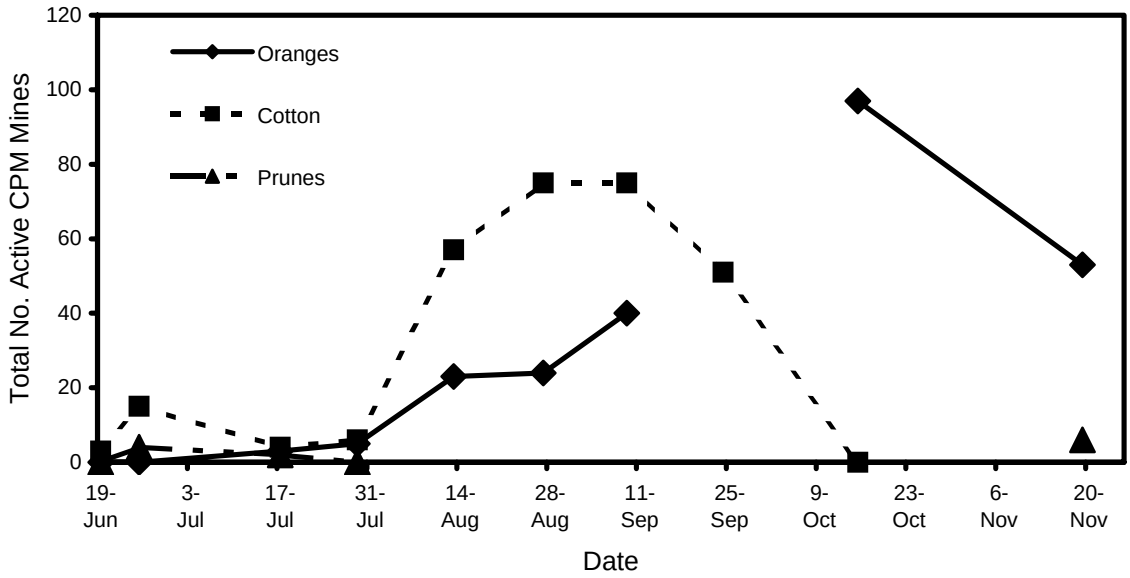


Figure 2. The Total Number of Active CPM Mines found in a 10-Minute Search of Habitats Located Adjacent to Site 3 in Tulare County in 2002



Movement of CPM from cotton and table grapes into oranges and prunes was also evident (Figure 2). For the oranges, the density of CPM began to increase in early August, peaking in mid October. This coincided with the timing of the senescence of the cotton and table grapes. Mining in the stems of prunes was found early in June and again in November and January, suggesting that CPM may overwinter in this host (Figure 2).

The second pattern of CPM abundance in a table grape vineyard, as demonstrated by the data from Site 4, was characterized by three general peaks in abundance: mid-July, mid-August, and late September (Figure 1). In addition, CPM appeared in this vineyard about a month later than that seen at Site 3. Rachis mining occurred from early July through October. Berry mining was found in July, September, and October, although the number of berries mined was extremely low (less than one percent of the clusters examined had berry mines).

The pattern of abundance in the surrounding habitats reflected the pattern found in the table grape vineyard (Figure 3). The adult CPM appeared to arrive at this site in early July with mining beginning in the oranges and mature grape habitats at about the same time. The density of CPM mines continued to increase into September. In mid-October, cheeseweed in the orange grove was extensively mined. In the almond grove, inactive mines were found in June, and active mines were found in July. This pattern of activity suggests that almonds may be used as a host in the winter through early summer.

There are hosts of CPM that are thought to harbor CPM throughout the year, and these include oleander and willow. At Site 5, one of the adjacent habitats is an oleander hedge. On all sampling dates June through January, active CPM mines could be found in the hedge (Figure 4).

The data collected in the studies conducted in Tulare County in 2002 suggest a pattern of movement among various habitats by CPM (Table 1). It appears that there are habitats in which CPM is present year-round at varying densities. For example, there appears to be resident CPM populations in oleander and citrus, and may be one in willow (data not collected). In late spring, CPM move out of year-round habitats and begin to infest walnuts, grapes (mature), plums, dry beans, early cotton, and weeds. In early summer, CPM mines can also be found to a limited degree in almonds and prunes. In mid to late summer, densities of CPM peak in dry beans, cotton, and grapes (mature and young). In addition, CPM mines can be found in kiwi stems, and pistachio stems and hulls. Throughout the fall, CPM densities increase in citrus, and it moves into possible overwintering hosts (e.g., weeds and prunes).

Table 1. Proposed pattern of seasonal movement of CPM from habitat to habitat. Habitats in italics are assumed to harbor CPM, but data has not been generated. Crops in bold show when CPM reaches peak density within a crop.

SPRING	SUMMER	FALL	WINTER
Almonds			
Citrus	Citrus	**Citrus**	Citrus
Cotton	Pistachio		Weeds
Dry Beans	Kiwi		Walnuts
Grapes	**Dry Beans**	Weeds	Almonds
Oleander	**Oleander**	**Oleander**	Oleander
Plums	**Cotton**		Plums
Walnut	**Grapes**	Prunes	Prunes
Weeds			
Willow	Willow	Willow	Willow

Figure 3. The total number of active CPM mines found in a 10-minute search in habitats located adjacent to Site 4 in Tulare County in 2002.

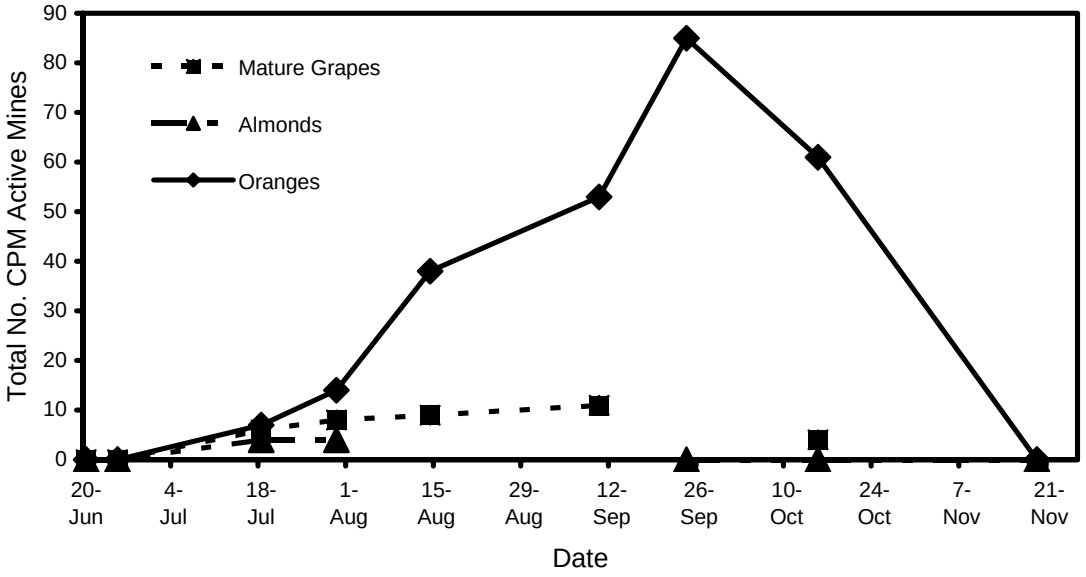
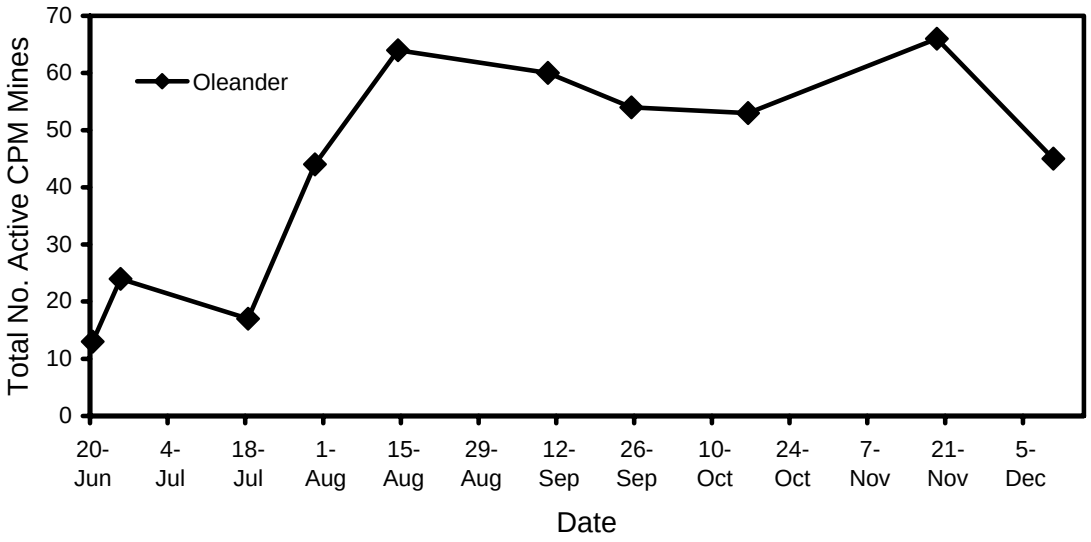


Figure 4. The total number of active CPM mines found in a 10-minute search of an Oleander hedge at Site 5 in Tulare County in 2002.



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